



The Run IIb CDF Detector Project

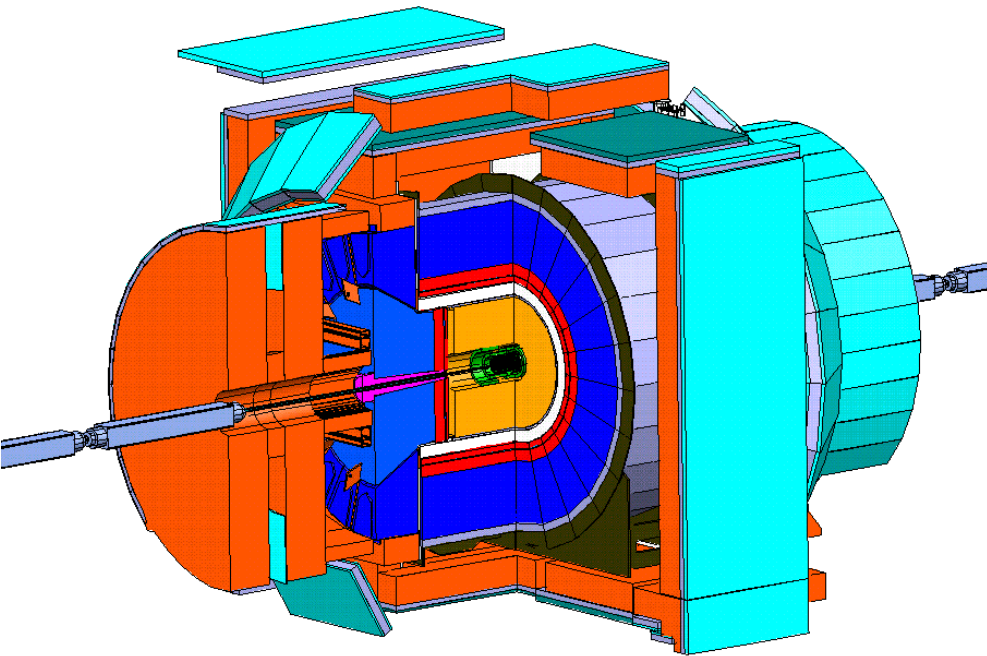
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20 July 2004



CDF for Run II



- The current detector was designed/built based on Run IIa specifications:
 - Maximum instantaneous luminosity of $2 \times 10^{32} \text{cm}^{-2} \text{s}^{-1}$.
 - Integrated luminosity of 2 fb^{-1} .
 - Operation with 396 ns and 132 ns bunch spacing.
- As in Run I, CDF's strength lies in its tracking system
 - Good momentum precision
 - Good vertex precision – b hadron identification



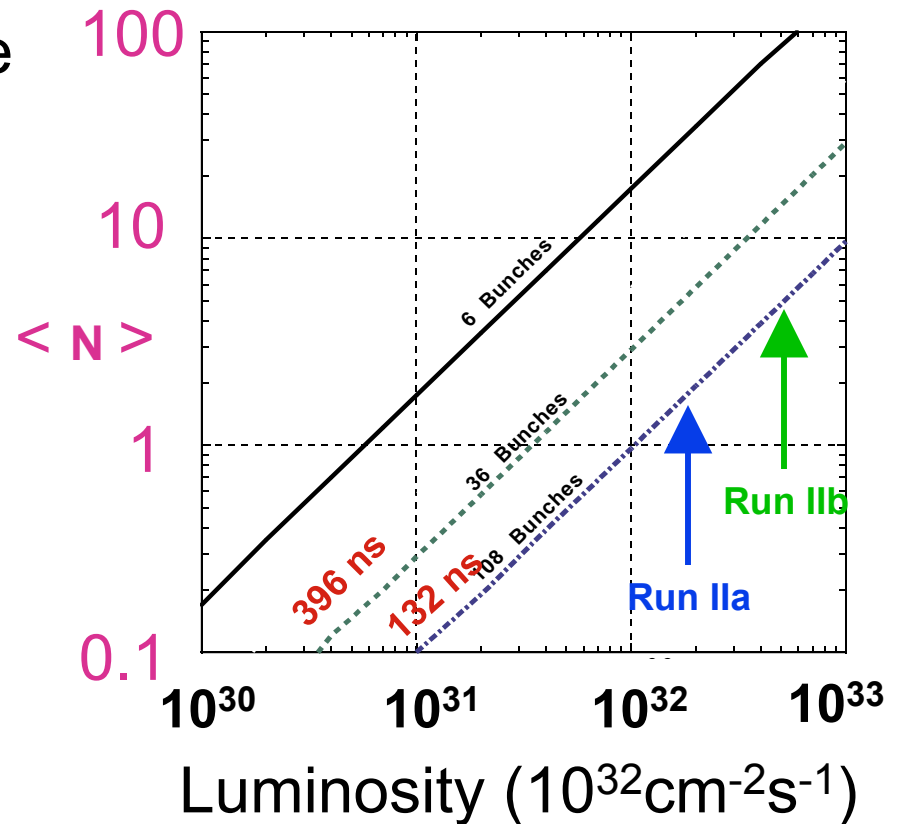
The Run IIb Evolution

- Original(2001) specifications for Run IIb:
 - Maximum instantaneous luminosity of $4\text{-}5 \times 10^{32} \text{cm}^{-2} \text{s}^{-1}$ (132 ns).
 - Integrated luminosity of 15fb^{-1} .
 - Maintain the Higgs search and the high P_T program.
- These operating conditions motivated the projects
 - Integrated luminosity - radiation damages the tracking system.
 - Instantaneous luminosity - results in high occupancy events and requires increase data acquisition bandwidth.
- Plans were developed and shown to the PAC, two Director's reviews and the Technical Review Committee during 2001-02.



Instantaneous Luminosity

- Summer 2002 (after the PAC meeting) saw the report of the “132 ns Committee”
- New plan
 - 396 ns operation
 - Instantaneous luminosity will be “leveled”
 - Effective average will be $4 \cdot 10^{32} \text{cm}^{-2} \text{s}^{-1}$ equivalent
- CDF scrambled, and used $4 \cdot 10^{32} \text{cm}^{-2} \text{s}^{-1}$ at 396 ns crossing as a benchmark





Baseline Approval

- DOE Baseline Readiness Review (Lehman) went well for both experiments in Sep. 2002.
- External Independent Review was held in Nov. 2002.
 - Went well. The findings were addressed.
 - However, the Halloween accelerator review introduced the concept of “design” and “base” luminosity
- A conditional Critical Decision 3 was granted in Dec. 2002.
 - Called “CD-3a” – one year approval



New Luminosity Standard

- The luminosity projections of Oct 2002 were reduced at the July 2003 DOE review.
- Building the silicon no longer made sense
 - Formally cancelled in Sep.
- The project was “rebaselined” in Dec. 2003
 - All DAQ and calorimeter projects were retained
 - Some budget was set aside for possible silicon needs
 - Total DOE equipment cost dropped \$25.0M→\$10.4M
 - Ended formal Earned Value reporting
- Note that installation is not included in the project.



Tevatron Plan - July 2003





CDF's Run IIb Projects

- Closeout of the Silicon Detector upgrade (WBS 1.1)
- Calorimeter upgrades (WBS 1.2)
 - Preshower replacement
 - Electromagnetic timing
- Data Acquisition and Trigger upgrades (WBS 1.3)
 - Replacement of drift chamber TDCs
 - Upgrade of Level 2 trigger infrastructure
 - Upgrade of track trigger
 - Upgrade of the event builder
 - Replacement of Level 3 trigger processors
 - Upgrade of the silicon vertex trigger
 - Upgrade of silicon detector data acquisition



Project Costs

	Total Obligations in Current Year \$K					
	FY02	FY03	FY04	FY05	FY06	Total
Silicon	\$ 1,670	\$ 1,525	\$ 1,110	\$ 713	\$ 55	\$ 5,073
Calorimeter	\$ 41	\$ 597	\$ 617	\$ 62	\$ 49	\$ 1,366
DAQ	\$ 22	\$ 363	\$ 1,307	\$ 4,069	\$ 36	\$ 5,796
Administration	\$ -	\$ 213	\$ 422	\$ 433	\$ 240	\$ 1,309
Total	\$ 1,733	\$ 2,698	\$ 3,456	\$ 5,277	\$ 380	\$ 13,544

	Funding Plan in Current Year \$K				
	FY02	FY03	FY04	FY05	Total
DOE MIE	\$ 3,460	\$ 3,509	\$ 1,673	\$ 1,732	\$ 10,375
DOE R&D	\$ 1,670	\$ 480			\$ 2,150
Foreign Contributions	\$ 39	\$ 342	\$ 252	\$ 10	\$ 643
U.S. Universities	\$ 24	\$ 225	\$ 103	\$ 26	\$ 378
Total	\$ 5,193	\$ 4,556	\$ 2,028	\$ 1,768	\$ 13,545

- All costs are in AY \$K, and include G&A
- Additional contributed labor is required (but not included)
 - Physicists are not considered part of the project cost.



DOE MIE Cost

	Base Cost	Cont.	Total
Silicon	1673	0	1673
Calorimeter	395	281	676
DAQ/Trigger	4644	2074	6718
Admin.	959	349	1308
Total	7671	2704	10375

Total costs of DOE Equipment funds in AY \$K

- Our overall contingency is 35%.
 - \$7K has been used since the baseline was reestablished.



Project Schedule

- Resource loaded schedules exist for all subprojects
- Status against milestones is reported monthly
- High level milestones called out in the PMP and PEP.
 - Unchanged with the rebaseline.
- Extension requires Directorate (DOE) approval
 - Completion of the calorimeter upgrades – May 05 (Jan 06)
 - Completion of the DAQ upgrades – Sep 05 (Jan 06)
- Consequently, the project is near its completion date.
- Project completion dates are not tied to operations
 - May not match shutdown periods



Silicon closeout

- The silicon detector development is complete
- Cost codes will remain open until the end of FY04
 - Most costs are incurred – there are a few details that remain.
- Results have been presented at IEEE, DPF in a few weeks.
- NIM article is being written.



Outer stave installation

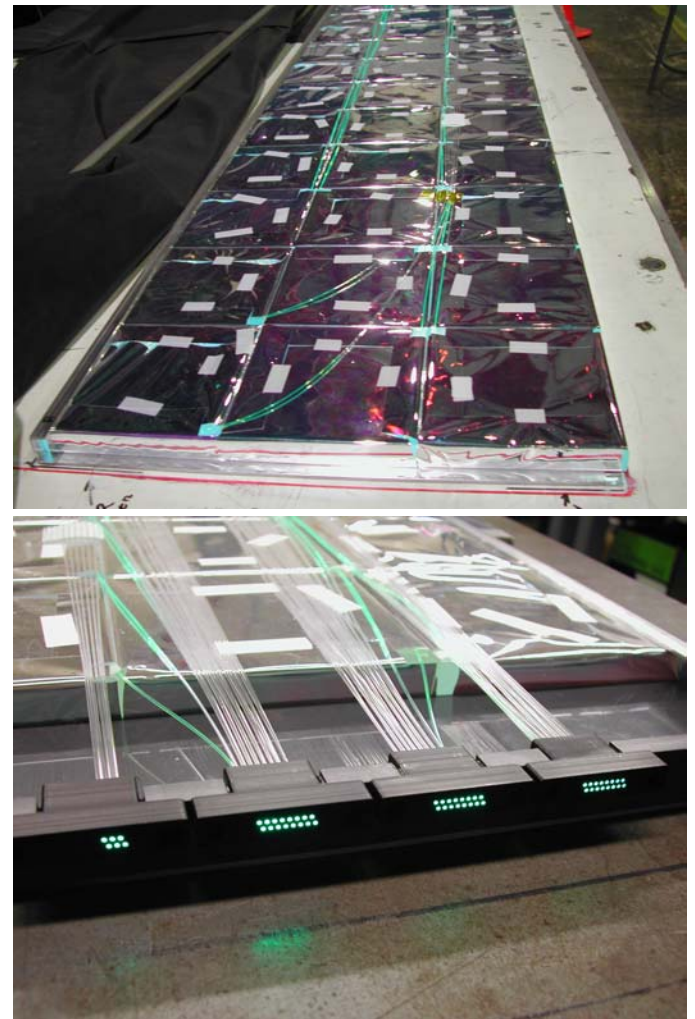
Layer 0 segment





Calorimeter Upgrades

- The new preshower will replace the existing CPR.
- One of the last pieces of gas calorimetry (most replaced for Run IIa)
 - Replacement uses scintillator
 - Optical fiber readout, with 16 channel phototubes
 - Not a new technology for CDF
- Also, timing capability will be added to the electromagnetic calorimeter

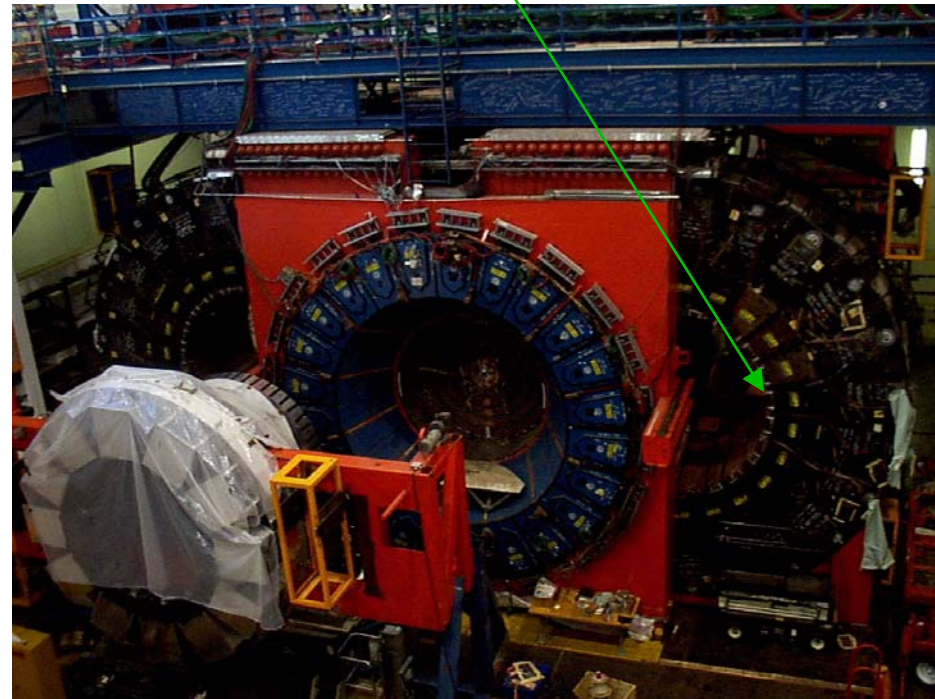




Preshower Installation

- We plan to install both the Preshower/crack system and the EM timing system in the fall 2004 shutdown.
- This is a challenging job
 - Difficult access
 - Lots of work for the time available
 - More discussion in other talks

CPR location





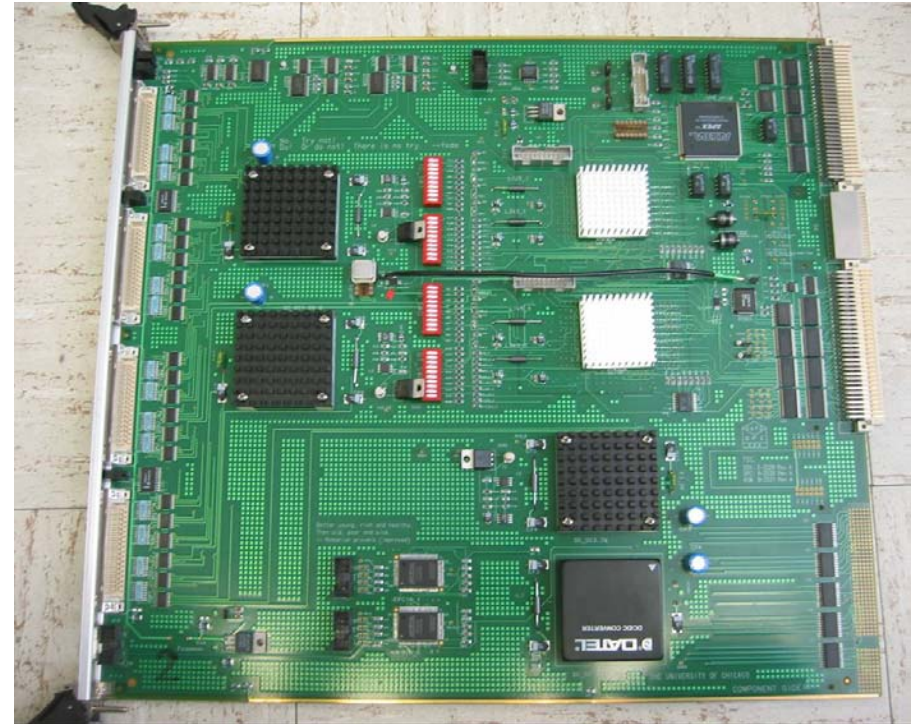
Data Acquisition

- The Run IIb high P_T program requires a level 2 trigger accept rate of at least 750 Hz.
 - Currently limited to 300 Hz
 - TDCs and Event Builder upgrades are required
- High occupancy drives up track trigger fake rates
 - Upgrades to both tracking triggers XFT and SVT
- Duration of the run and complexity of events motivates processor upgrades
 - Level 2 – more flexible, uses standard interface and PCs
 - Level 3 – More power possible with newer PCs



TDC Status

- Prototype TDCs have been undergoing tests since March.
- Production readiness review held in May
- The TDC needs no significant layout changes.





Event Builder Status

- The project is well underway.
 - Test setup has demonstrated sufficient bandwidth
 - 1 kHz readout will be met
- Full order for CPUs has been placed
- Current work is on developing software for the system
 - On track for a summer 2005 installation.



Level 2

- Production of the Pulsar is nearly complete
- All mezzanine cards are done.
- Commissioning of the various triggers paths is in progress
 - Testing parasitically with operations – through this summer.





Track Trigger Status

- The track trigger (XFT) has fallen behind schedule.
- XFT had an internal scope review on 25 May 2004.
- Significant progress has been made several areas
 - Simulations have improved
 - Trigger rate data covers a wider range of luminosity
- Conclusions
 - A factor of 3-4 in fake rate improvement is needed.
 - Preserves high P_T rate to $3 \cdot 10^{32}$
 - Preserves B physics triggers to $1.5 \cdot 10^{32}$



XFT

- The conclusion of the review is that the baseline scope is not realistic.
- A followup review on 25 June presented a new proposed scope
 - Current axial system will remain – not upgraded.
 - Proposed upgrade adds additional stereo layers.
 - Commissioning is now possible without down time.
- Although still seen as difficult in the time remaining, this upgrade is achievable.
- Scope change is requested.



SVT Upgrade

- The baseline SVT upgrade was planned for the change in silicon geometry.
 - Modernization and speed was secondary, but needed
- Workshops held in April and June, 2004 helped focus our plans here
- An internal review on 29 June evaluated the proposed scope
 - A resource loaded schedule has been developed
- Cost and milestones have been finalized, and we have a Change Request to establish this project.



Silicon in Run IIb

- Several silicon related subprojects were retained in the rebaseline exercise.
 - We must operate the current detector ~ 8 years.
 - Operation is planned in higher occupancy environment.
- A Silicon Longevity Committee was convened.
 - Met Feb – June, explored various issues
 - Their task was to identify areas of risk, suggest mitigations.
 - The report is now available.
- No significant procurements were identified in this process.



Silicon in Run IIb

- Several areas were identified where greater physicist commitment is needed.
 - Replace expertise as people move on.
 - Maintain legacy software, firmware, documentation.
- In general, these must be solved by the collaboration.
 - Largely manpower issues, long term MOU responsibilities
- Consequently, no projects have been identified as necessary for a Silicon DAQ upgrade.
- We have a Change Request to release WBS 1.3.7.



Installation - 2004

- We plan calorimeter installations for the fall shutdown
- EM Timing installation – recently reviewed
 - Recently discovered to need more parts
 - Cable layout forces need for more ASDs
 - Transition cards were damaged when modification was attempted – need to be remade.
 - Installation will begin when parts are in hand
- Preshower installation will drive the collision hall work
- We believe this can be completed in 12 weeks
 - We will stop if necessary – resume it later



Installation - 2005

- Data acquisition and trigger installations are planned.
- Collision hall needs
 - TDC installation/checkout
 - XFT transition cards and cabling
 - No major mechanical projects
- DAQ down time
 - Event builder installation



Project Tracking

- The monthly report is our main tool for tracking
- It includes
 - Narration from each level 3 subproject
 - Milestone status
 - Current obligations and cost performance reports
 - Monthly effort reports also maintained, but not distributed
- Formal earned value reporting was done in 2003, then ended with the rebaseline.
 - Total project was below \$20M
- This requirement has been reinstated, so we plan to include earned value in future reports.



Project Status

- Project status as measured by costs:

Subproject	% Complete	SPI	CPI
Silicon Closeout	1.00	1.00	1.28
Preshower	0.69	0.83	0.82
EM Timing	1.00	1.00	1.52
TDCs	0.09	0.64	0.65
XFT	0.00	0.01	-
Level 2	0.93	1.34	2.24
Event Builder	0.16	0.39	1.46
Level 3/DAQ Comp.	0.00	0.00	0.00
SVT	0.00	0.00	0.00
Silicon DAQ	0.00	0.00	0.00
Total Project	0.38	0.83	1.27

$$\%Com. = \frac{BCWP}{BAC}$$

$$SPI = \frac{BCWP}{BCWS}$$

$$CPI = \frac{BCWP}{ACWP}$$



Changes in Scope

- We have the following changes to our scope that we wish to make at this time:
- Track Trigger (XFT) –
 - Retain the axial system currently in use
 - Increase the stereo coverage
- Silicon Vertex Trigger (SVT) –
 - Higher speed system for the occupancy
 - Build infrastructure to handle more patterns
- Silicon Data Acquisition
 - We find no need for upgrades here



Impact on Cost

- If approved, the new scope changes will result in the following total cost changes (costs in AY \$K):

Subproject	Baseline	New Scope	Change
XFT	\$ 1,147	\$ 1,443	\$ 296
SVT	\$ 174	\$ 296	\$ 122
Silicon DAQ	\$ 854	\$ -	\$ (854)
Total	\$ 2,175	\$ 1,739	\$ (436)



Summary

- We have developed a well focused program to maintain the high P_T physics program through the full range of Run II luminosity
 - Low P_T program also gains, since its range is extended
- Several projects are in production, near completion
- Others that are behind have had a change of scope
 - Internal review process used to focus the efforts
 - Completion by Sep 2005 is realistic.